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## A REVIEW OF GEOGRAPHIC VARIATION IN CONTINENTAL POPULATIONS OF THE RUBY-CROWNED KINGLET (*Regulus calendula*)

M. Ralph Browning\*

### INTRODUCTION

Four races of *Regulus calendula* Linnaeus are recognized in the A.O.U. check-list (1957), including the nominate form (type locality: Philadelphia, Pennsylvania), which breeds from northwestern Alaska south to central British Columbia and eastward to eastern North America. The other three races that are recognized occur in western North America, the first described by Ridgway (1876) as *obscurus* (type locality: Guadalupe Island, Baja California), a small, dark form found only at the type locality. This insular race is distinct from all other populations of *R. calendula* and is not considered further in this paper. The two other races are *grinnelli* Palmer, 1897 (type locality: Sitka, Alaska) and *cineraceus* Grinnell, 1904 (type locality: Strain's Camp, Mt. Wilson, Los Angeles County, California). According to the check-list, the former occurs from southern coastal Alaska to southwestern British Columbia, whereas the latter occurs from south-central British Columbia eastward to Montana and the Rocky Mountains and southward to Arizona and California.

The taxonomic status of the continental races has recently aroused discussion by Phillips *et al.* (1964), Phillips (1964), and Hubbard and Crossin (1974), with the status of the race *cineraceus* the subject of most of the controversy. Ridgway (1904) was the first to examine the distinction of this form, and as the result he synonymized *cineraceus* with nominate *calendula*. However, he commented that the race was possibly valid, as he did not have critical specimens available for comparison. Nonetheless, he listed specimens from California in his table of measurements and states that the California series was similar to the eastern specimens in size and color. Bishop (1926) later argued that *cineraceus* was distinct, and in the subsequent A.O.U. check-list (1931) the name was accepted as applicable to those western populations that occur elsewhere than the range of *grinnelli*. Hellmayr (1934) also recognized *cineraceus*, remarking that the name applied to the large, gray populations of the West.

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\*National Fish and Wildlife Laboratory  
National Museum of Natural History  
Washington, D.C. 20560

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Library of Congress  
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Recently, Phillips (1964) synonymized *cineraceus* with *calendula*, while also describing a new western race, *arizonensis* (type locality: vicinity of Phelps Ranger Station, White Mountains, Arizona). Phillips gave the breeding range of *arizonensis* as the mountains of Arizona and probably most of the boreal regions of the western United States. Hubbard and Crossin (1974) followed Phillips' treatment synonymizing *cineraceus*, but they questioned the validity of *arizonensis* as being any more separable from the nominate form than *cineraceus*. Pending a revision of the species, they suggested that all continental populations except *grinnelli* be included in the nominate *calendula*. Because of this lack of unanimity, I compared specimens in order to better assess the geographic variation of the continental populations of *Regulus calendula*.

#### METHODS

Adult specimens of *R. calendula* were compared in coloration (N = 500), wing chord (N = 270), and length of tail (N = 237). Measurements, all in millimeters, were made of specimens collected on their breeding grounds, which are here defined as areas of occurrence during the months of May and June, depending on latitude. Specimens were segregated by age so as to exclude all first-year birds. This was achieved by examination of crown color (in males), shape of the rectrices (see Svenson, 1970), and data on the specimen labels. All specimens that were doubtfully collected on their breeding grounds or were of uncertain age were excluded.

Statistical comparisons include Student's *t*-test and coefficient of difference (C.D.), the latter a method to depict the percent of joint nonoverlap among populations (cf. Mayr, 1969).

#### RESULTS AND DISCUSSION

The races of *R. calendula* have been characterized on the basis of size and coloration. Palmer (1897) described *grinnelli* as sooty dark olive above, with the area surrounding the crown patch blackish, the throat dusky gray, and the abdomen yellowish. He described *grinnelli* as being darker and smaller than *calendula*. Grinnell (1904) characterized *cineraceus* as being larger and grayer than *grinnelli* and *calendula*. Phillips (Phillips *et al.*, 1964) stated that populations of *R. calendula* are subject to a great amount of fading, and he found that in fresh fall plumage, specimens of *cineraceus* and *calendula* are identical in coloration. He concluded that only measurements showed populational differences in the ranges attributed to these two forms.

The following analysis is my attempt to clarify conflicting statements on the geographic variation of this species:

**Wing chord.** Comparisons of wing chord in my samples of *R. calendula* (Tables 1 and 2) demonstrate only minor differences among populations. In addition,

Table 1: Measurements of Wing Chord and Length of Tail of Adult Male Specimens of *Regulus calendula* Collected During the Breeding Months

| Sample                          | Wing chord |      |      |           | Tail |      |      |           |
|---------------------------------|------------|------|------|-----------|------|------|------|-----------|
|                                 | N          | Mean | S.D. | Range     | N    | Mean | S.D. | Range     |
| Alaska                          | 10         | 59.8 | 1.4  | 56.8–61.1 | 5    | 47.5 | 1.3  | 45.3–48.3 |
| NW Territory                    | 4          | 58.2 |      | 56.1–60.6 | 4    | 46.7 |      | 43.0–50.5 |
| N British Columbia              | 7          | 57.2 | 1.6  | 54.3–58.8 | 6    | 45.8 | 2.1  | 43.0–48.5 |
| S British Columbia              | 10         | 59.8 | 1.3  | 57.6–61.3 | 10   | 45.1 | 1.5  | 42.3–47.4 |
| Washington                      | 13         | 59.6 | 1.3  | 57.5–62.6 | 12   | 46.1 | 0.8  | 44.9–47.8 |
| Oregon                          | 21         | 60.0 | 0.9  | 57.8–61.6 | 14   | 46.6 | 1.1  | 44.4–48.3 |
| N California <sup>1</sup>       | 8          | 60.3 | 1.3  | 58.2–62.9 | 8    | 45.8 | 1.6  | 43.2–48.2 |
| Central California <sup>2</sup> | 7          | 60.3 | 1.0  | 58.4–61.1 | 7    | 46.8 | 0.8  | 45.5–47.5 |
| S California <sup>3</sup>       | 7          | 60.2 | 0.8  | 59.3–61.5 | 7    | 46.0 | 1.1  | 44.1–47.9 |
| California total                | 31         | 60.5 | 1.0  | 58.2–62.9 | 29   | 46.4 | 1.2  | 43.2–48.8 |
| Idaho                           | 15         | 60.2 | 1.0  | 58.1–61.8 | 15   | 46.8 | 1.3  | 44.2–49.2 |
| N Nevada <sup>4</sup>           | 13         | 60.5 | 1.3  | 58.8–63.2 | 13   | 47.6 | 1.7  | 45.1–51.2 |
| S Nevada <sup>5</sup>           | 10         | 60.2 | 1.6  | 57.4–62.8 | 10   | 47.5 | 2.4  | 44.3–51.4 |
| Nevada total                    | 28         | 60.4 | 1.3  | 57.4–63.2 | 28   | 47.6 | 1.9  | 44.8–51.4 |
| "arizonensis"                   | 7          | 61.6 | 0.6  | 60.4–62.4 | 7    | 47.4 | 1.5  | 45.5–50.5 |
| Arizona total <sup>6</sup>      | 13         | 60.9 | 1.1  | 58.5–62.4 | 11   | 46.4 | 2.5  | 40.8–48.5 |
| N Alberta                       | 4          | 57.3 |      | 55.6–58.9 | 3    | 45.8 |      | 44.9–47.3 |
| S Alberta                       | 6          | 58.9 | 1.4  | 57.3–61.1 | 4    | 45.3 | 1.6  | 43.6–47.7 |
| N U.S. Rocky Mtns.              | 4          | 59.8 |      | 57.3–62.1 | 2    | 43.6 |      | 43.0–44.1 |
| Eastern N America               | 12         | 58.3 | 1.5  | 55.8–61.4 | 10   | 45.6 | 1.4  | 44.0–47.8 |
| <i>grinnelli</i>                | 14         | 56.2 | 1.2  | 54.1–58.3 | 14   | 44.3 | 1.1  | 42.0–46.4 |

<sup>1</sup>Modoc Co.

<sup>2</sup>Mono Co.

<sup>3</sup>San Bernardino and Riverside counties

<sup>4</sup>Elko and Humboldt counties

<sup>5</sup>Clark and Lincoln counties

<sup>6</sup>Includes "arizonensis"

some of the samples of males from western North America demonstrate clinal variation; e.g., specimens from Idaho average smaller than those from Arizona (Fig. 1).

The means of several of the samples were compared using Student's *t*-test. The mean of the sample from eastern North America is significantly ( $P < 0.05$ ) smaller than those from Arizona ( $t = 4.74$ ,  $P < 0.0001$ ), Alaska ( $t = 2.32$ ,  $P < 0.02$ ), and California ( $t = 5.26$ ,  $P < 0.0001$ ). However, the eastern sample is not significantly smaller than those of birds from such areas as Oregon ( $t = 0.79$ ,  $P < 0.40$ ). Student's *t*-test of other populations revealed significant differences between the means of the samples from northern British Columbia and those of Alaska, between those of northern and southern British Columbia, and between southern British Columbia and California. Results of *t*-tests between the means of other samples are not significant.

Table 2: Measurements of Wing Chord and Length of Tail of Adult Female Specimens of *Regulus calendula* Collected During the Breeding Months

| Sample             | Wing chord |      |      |           | Tail |      |      |           |
|--------------------|------------|------|------|-----------|------|------|------|-----------|
|                    | N          | Mean | S.D. | Range     | N    | Mean | S.D. | Range     |
| Alaska             | 5          | 56.2 | 1.5  | 53.8-57.9 | 3    | 43.5 |      | 42.4-45.2 |
| N British Columbia | 3          | 55.3 |      | 54.5-55.8 | 3    | 43.7 |      | 42.1-45.3 |
| Washington         | 3          | 56.3 |      | 55.5-56.9 | 3    | 43.6 |      | 43.0-44.5 |
| Oregon             | 5          | 55.6 | 2.0  | 52.5-56.8 | 2    | 43.8 |      | 43.5-44.1 |
| California total   | 17         | 57.1 | 1.3  | 54.6-59.5 | 16   | 44.6 | 1.5  | 41.6-46.7 |
| Idaho              | 4          | 56.2 |      | 55.7-57.0 | 4    | 42.7 |      | 42.2-43.0 |
| Nevada total       | 13         | 57.0 | 1.7  | 54.0-59.2 | 13   | 44.6 | 1.8  | 41.0-46.6 |
| Arizona total      | 7          | 56.7 | 2.5  | 52.5-60.2 | 4    | 43.6 |      | 40.9-44.9 |
| Alberta total      | 3          | 56.1 |      | 54.2-57.3 | 3    | 44.2 |      | 43.2-45.6 |
| N U.S. Rocky Mtns. | 3          | 55.7 |      | 54.0-58.2 | 2    | 41.4 |      | 41.0-41.9 |
| Eastern N America  | 9          | 55.8 | 1.5  | 53.7-58.0 | 7    | 45.4 | 1.9  | 42.8-49.0 |
| <i>grinnelli</i>   | 6          | 52.9 | 1.0  | 51.6-54.3 | 6    | 41.3 | 1.1  | 39.6-42.7 |

Although the differences between the mean wing chord in some samples of the males are statistically significant, there is considerable overlap in measurements between most samples (Table 1). The amount of joint nonoverlap between several samples was determined with results that are below the level (90%) suggested by Mayr (1969) for recognizing subspecific differences. This level is equivalent to saying that less than 75% of the specimens of one sample can be separated from 97% of another sample of specimens. To compute the C.D., I purposely compared samples having extremely high or extremely low means in order to gauge as rapidly as possible the prospects of separation. In all instances the C.D. values fell below the 90% joint nonoverlap level, except in the case of the samples compared with *grinnelli*.

The degree of variation in wing chord between samples of females (Table 2) is even less than that between males (Table 1). Although the sample from Arizona has a greater mean in wing chord than in all other samples, the range of variation is so great as to include even the relatively short-winged eastern sample (Table 2).

Because variation in wing chord could be related to altitude of breeding area, I tested a sample of 54 males from Nevada and California for correlation of wing chord with elevation. There is no correlation ( $r = 0$ ).

My averages for wing chord of birds from eastern North America are greater than those from New Hampshire reported by Sawyer (1961), especially for males, for which our values differ significantly ( $t = 2.09$ ,  $P < 0.05$ ). However, comparable measurements reported by Phillips (1964) and Godfrey (1966) are

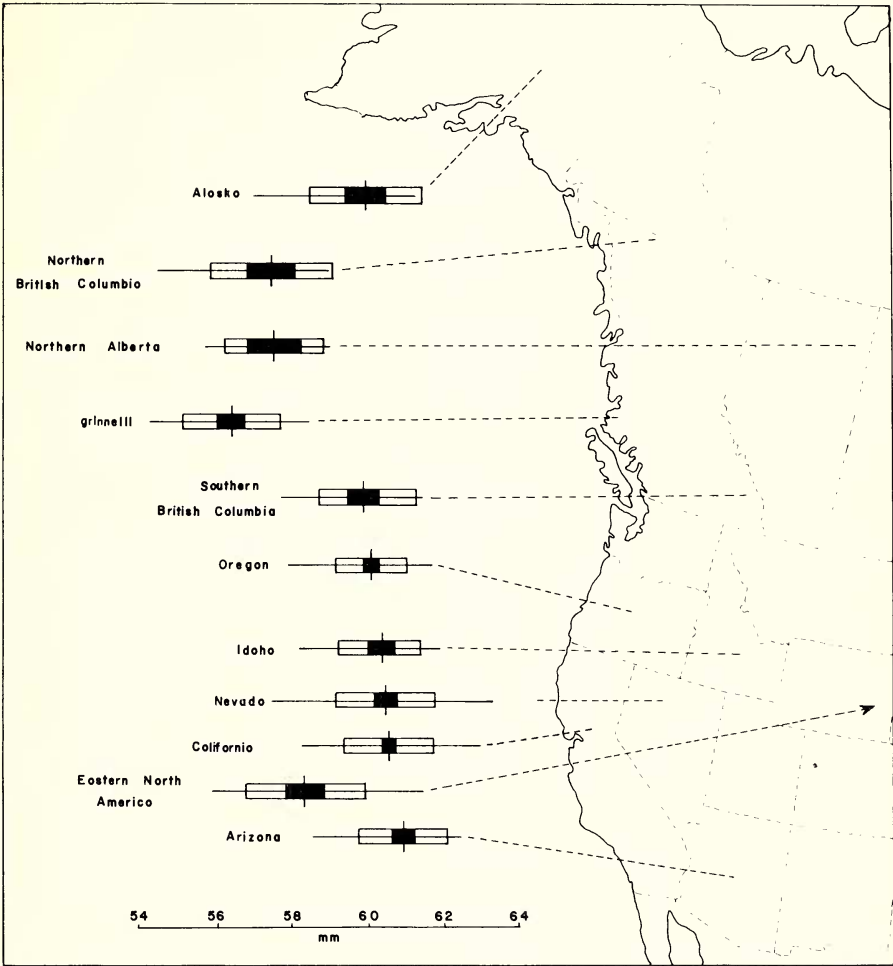


Figure 1: Comparison of wing chord measurements of adult male *Regulus calendula*. Horizontal lines show the ranges. On each side of the mean, shown as a vertical line, are one standard error, indicated by a solid rectangle, and one standard deviation, indicated by an open rectangle. The number of specimens in each sample is listed in Table 1.

similar to mine; e.g., the latter's mean of 57.8 mm (range 55.0 to 61.1) for adult male *calendula* (*sensu* A.O.U., 1957). My figures also generally agree with those of Ridgway (1904) of eastern birds although his maxima for eastern specimens exceed values for specimens measured by me. From the preceding, I conclude that the sample from New Hampshire measured by Sawyer does not adequately represent the range of variation of eastern populations.

Phillips (1964) gave the range in wing chord of *arizonensis* as 60.4 to 63.5 ( $\bar{x}$  = 61.5) for summer males and "56.3+" to 58.8 for females. For eastern populations, Phillips reported maxima of 60.0 and 58.0 for males and females, respectively. Phillips' measurements of the wing chord of the holotype of *cineraceus* is 60.0, 0.4 mm less than the minimum in wing chord of his series of *arizonensis*.

In summary, the geographic variation in *R. calendula* in wing chord is slight. The northwestern race, *grinnelli*, has a shorter wing than all other samples of the species from the continental populations. Southwestern birds have slightly longer wings than those in the other samples, but the range of individual variation includes that of most other samples, including birds from eastern North America. Based on wing chord, eastern and western populations, other than *grinnelli*, cannot be separated at any meaningful subspecific level.

**Tail.** Comparisons of measurements of length of tail for males and females (see Tables 1 and 2) do not reveal any significant geographic variation, and measurements overlap considerably. Means in males demonstrate that birds having the longest tails are from Alaska and the southwestern United States. Specimens having the shortest tails are from the northern U.S. Rocky Mountains and from eastern North America. Comparisons of my measurements with those of Sawyer (1961) and Phillips (1964) reveal that the means for my samples of males and females are, on the average, larger. These differences (possibly due to technique) do not affect my conclusions because I measured all populations and am not relying on the measurements of others.

**Weight.** A small number of weights taken from the specimen labels of birds from western North America is presented in Table 3. Although these are too few and too geographically scattered to be useful to compare for taxonomic discussion, it is interesting that adult males taken during the breeding months have weights similar to those of birds collected during the fall. Murray and Jehl (1964) reported a mean weight of 5.8 grams (N = 66; sexes apparently pooled) for birds from eastern North America; but birds from New Hampshire, according to Sawyer (1961), averaged 7.19 and 6.74 grams for males and females, respectively.

**Coloration.** Plumage of breeding birds becomes extremely worn during summer and, therefore, this character is useless for making comparisons of coloration. Except for *grinnelli*, specimens in fresh plumage are identical in dorsal and ventral coloration among continental populations. Having examined over 500 specimens, many in fresh fall plumage, I agree with Phillips that the populations of *R. calendula* cannot be separated on the basis of coloration.

## CONCLUSIONS

Morphological variation in continental populations of *R. calendula* is slight, with differences found in wing chord, length of tail, and plumage color among some populations. Birds along the coastal regions of southern Alaska south to southwestern British Columbia having significantly shorter wings are validly

Table 3: Weights (in grams) of Adult Specimens of *Regulus calendula*\*

|                                 | <i>N</i> | <i>Mean</i> | <i>S.D.</i> | <i>Range</i> |
|---------------------------------|----------|-------------|-------------|--------------|
| S British Columbia              | 8        | 6.21        | 0.33        | 5.8–6.3      |
| Oregon                          | 13       | 6.07        | 0.51        | 5.2–7.2      |
| California                      | 6        | 6.23        | 0.72        | 5.7–7.5      |
| Nevada                          | 26       | 6.25        | 0.77        | 5.5–9.0      |
| Nonbreeding adults <sup>†</sup> | 11       | 6.19        | 0.53        | 5.5–7.3      |
| <i>Females</i>                  |          |             |             |              |
| Oregon                          | 3        | 6.27        |             | 5.3–7.3      |
| California                      | 4        | 6.03        |             | 5.7–6.4      |
| Nevada                          | 16       | 6.23        | 0.68        | 5.2–8.0      |

\*All samples are from the breeding months unless otherwise indicated.

<sup>†</sup>From Nevada

separated as *R. c. grinnelli* Palmer. Specimens from the western United States have longer wings than those of western British Columbia, but are similar to birds from most of the remainder of Alaska and Canada and from the eastern United States. The amount of individual variation among these populations demonstrates extensive overlap; both large and small birds occur east and west of the Rocky Mountains. Tail length generally parallels wing chord among populations but demonstrates even fewer differences than the latter. Plumage color is uniform among continental populations, except that *grinnelli* is noticeably darker than other birds.

Based on these data, exclusive of *grinnelli*, western populations, whether ascribed to *cineraceus* (A.O.U., 1957) or to *arizonensis* (Phillips, 1964), are not separable from populations of eastern North America. Thus, the names *cineraceus* Grinnell, 1904 and *arizonensis* Phillips, 1964 are hereby considered synonyms of the name *calendula* Linnaeus, 1766. The distinctive race *grinnelli*, the only other separable continental race, breeds from southern Alaska to Vancouver Island. Contrary to earlier literature, *grinnelli* is probably a resident, as my examination of a large series of migrants collected as far south as southern California revealed only nominate *calendula* (*sensu lato*) southward.

#### SPECIMENS EXAMINED

Specimens from the following localities and collections (see Acknowledgments for abbreviations of museums) include birds collected on their breeding grounds and some specimens collected during spring and fall months. Entire series of specimens of nonbreeding birds from several collections (AMNH, DMNH, MCZ, MVZ, and USNM) were examined for variation in color but are not listed.

Alaska (USNM, 20; AMNH, 1; UAM, 1), Alberta (USNM, 3; MCZ, 2; UAMZ, 12), Arizona (USNM, 10; AMNH, 3; DMNH, 28), British Columbia (USNM, 5; BCPM, 9; MCZ, 21), California (USNM, 13; MVZ, 48; AMNH, 3; MCZ, 1), Colorado (AMNH 1; MCZ, 1), Idaho (USNM, 80), Labrador (USNM, 4), Mackenzie (USNM, 5; MCZ, 1), Manitoba (USNM, 1), Montana (USNM, 2; MCZ, 1), Nevada (USNM, 13; MVZ, 60), Newfoundland (USNM, 9), New Mexico (USNM, 6; AMNH, 2; DMNH, 1; UMMZ, 2), Nova Scotia (USNM, 4), Oregon (USNM, 11; MVZ, 16; CMNH, 2; DMNH, 1), Quebec (USNM, 4), Washington (USNM, 34; BMWSM, 3; UMMZ, 1), Wyoming (USNM, 5; AMNH, 1).

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#### BIBLIOGRAPHY

##### American Ornithologists' Union

- 1931 Check-list of North American birds, ed. 4. Amer. Ornith. Union, Lancaster.  
 1957 Check-list of North American birds, ed. 5. Amer. Ornith. Union, Baltimore.

##### Bishop, L. B.

- 1926 The distribution of the races of the Ruby-crowned Kinglet. *Condor*, 28:183.

##### Godfrey, W. E.

- 1966 The birds of Canada. *Nat. Mus. Canada Bull. No. 203*, pp. 1-428.

##### Grinnell, J.

- 1904 The Ashy Kinglet. *Condor*, 6:25.



Hellmayr, C. E.

- 1934 Catalogue of birds of the Americas. *Field Mus. Nat. Hist., Zool. Ser.*, **13**, part 7.

Hubbard, J. P., and R. S. Crossin

- 1974 Notes on northern Mexican birds. *Nemouria*, **14**:1-41.

Mayr, E.

- 1969 *Principles of Systematic Zoology*. McGraw-Hill Book Co., New York.

Murray, B. G., and J. R. Jehl, Jr.

- 1964 Weights of autumn migrants from coastal New Jersey. *Bird-Banding*, **35**:253-263.

Palmer, W.

- 1897 The Sitkan Kinglet. *Auk*, **14**:399-401.

Phillips, A. R.

- 1964 Notas sistematicas sobre aves Mexicanas, III. *Rev. Soc. Mexico Hist. Nat.*, **25**:217-242.

Phillips, A. R., J. T. Marshall, Jr., and G. Monson.

- 1964 *The Birds of Arizona*. Univ. Arizona Press, Tucson.

Ridgway, R.

- 1876 Ornithology of Guadeloupe Island, based on notes and collections made by Dr. Edward Palmer. *Bull. Geol. Geogr. Surv. Terr.*, **2**(2): 183-195.

- 1904 The birds of North and Middle America, part 3. *U. S. Nat. Mus. Bull.*, 50.

Sawyer, P. J.

- 1961 Report on the cause of mortality and the morphometry of seventy Ruby-crowned Kinglets killed at the WENH-TV tower in Deerfield, New Hampshire. *Bird-Banding*, **32**:162-168.

Svenson, L.

- 1970 *Identification Guide to European Passerines*. Naturhistoriska Riksmuseet, Stockholm.